REVIEW ON-GLASS FIBER GEOPOLYMER CONCRETE

Mr. Kakade V.D.[1], Dr. Kawade U. R.[2]
[1]*PG Scholar, Department of Civil Engineering, D.V.V.P. College of Engineering, Ahmednagar, Maharashtra.*
[2] *Head of department, Department of Civil Engineering, D.V.V.P. College of Engineering, Ahmednagar, Maharashtra.*

ABSTRACT

Concrete is the most durable, versatile & reliable construction material in the construction industry. Concrete is used more than any other manmade material in the world. Second most consumable material after water in the world is concrete. Portland cement production is the second carbon di oxide generator industry after the automobile industries which cause pollution to atmosphere. Producing one tons of cement releases 0.87 tons of CO2. The global release of CO2 from all sources is estimated at 23 billion tons a year and the Portland cement production accounts for about 7% of total CO2 emissions. So finding any other alternative for cement was needed to reduce pollution done during production of cement. Innovative construction materials which produce by chemical action of inorganic molecules can replace cement in concrete known as Geopolymer concrete. The Previous study shows results of experimental program on mechanical properties such as compressive strength, flexural strength, and split tensile strength of Geopolymer concrete in two composite 90% fly ash, 10% lime with varying percentage of glass fiber. The effect of addition of glass fibers on the different mechanical properties of geopolymer concrete by replacing 10% fly ash by lime was studied. Based on literature studied it was observed that glass fiber geopolymer concrete have relative higher strength than plain geopolymer concrete & it neglect the limitation of heat curing due to replacing lime in concrete mix.

KEYWORD: - *Geopolymer concrete, Fly ash, Strength, Glass fiber, Lime, Ambient curing etc.*

1. INTRODUCTION-

The development of science and technology is continues process for improvement of infrastructure all over the world. As infrastructure development with technology there is growing demand for concrete as construction material worldwide, this ultimately increases the demand for cement. Ordinary Portland cement is the most commonly use building material which is basic material of concrete, mortar & grouts. From last few years cement production in India increases from 207 million metric tons in 2010 to 407 million metric tons in 2017. That statistics makes India second largest cement producer in world. Production of Ordinary Portland Cement is highly energy intensive consume significant amount of non-renewable natural resources & release large amount of Co_2 in atmosphere. To producing 1 tons of cement required 2 tons of raw materials (shale & limestone) & release 0.87 tons of Co_2. The global release of CO2 from all sources is estimated at 23 billion tons a year and the Portland cement production accounts for about 7% of total CO2 emissions. Due to production of Portland cement it is estimated that by the year if 2020, the CO_2 emission rise by about 50% from the current level. Therefore to preserve the global environment from the impact of cement production,. In this regard it is now believed that necessary to replace Portland cement the geopolymer concrete is one revolutionary research related to construction material, resulting in low-cost and environmental friendly material as an alternative to the Portland cement. Geopolymer concrete is the best innovation which able to replace the use of cement in concrete. Geopolymer is a type of formless alumino-silicate product that shows the ideal properties of rock-forming element i.e. hardness, chemical stability and strength etc. properties of geopolymer includes high early strength, low shrinkage, sulphate resistance etc. Geopolymer concrete is the composite material of fly ash and alkaline liquid like sodium silicate & sodium hydroxide. Fly ash is by product of coal obtained from thermal power plant is plenty available worldwide. Fly ash is rich in silica and alumina reacted with alkaline solution produced aluminosilicate gel that acted as the binding material for the concrete. The curing method for geopolymer concrete is heat curing which help to achieve strength to the concrete. It was observed that geopolymeric cement generates 5-6 times less CO_2 than the Portland cement. Therefore the use of geopolymer concrete not only significantly reduces the CO_2 emission as compared to cement industries, but also utilizes the industrial wastes or by-products used in composition. The polymerization process happens in the geopolymer concrete caused to gain strength for that providing heat is major issue. Giving oven curing or heat curing is one of

the important part of geopolymer concrete that limitation can neglect by adding lime or cement in partial replacement of fly ash. The heat produced by lime and cement help to gain strength to geopolymer concrete but effect of these material in geopolymer concrete is slightly different in present study both material replaced by fly ash to study the effect of each.

Also the concept of adding fibers as reinforced in concrete is not new for enhance the strength of concrete. From the 1960's steel, glass and synthetic fiber were used in concrete and research into new fiber reinforced concrete continues today. Concerning with structural applications fiber concrete possesses many advantages compared to the traditional structural concrete such as increase in compressive, flexural and spilt tensile strength also durability and other properties positively affect.

2. LITERATURE REVIEW-

Mazaheripour H, Ghanbarpour S. the study shows the influence of polypropylene fibers on the performance of light weight self-compacting concrete on its wet condition as well as mechanical properties of the hardened concrete. Author conclude that applying 0.3% volume fractions of polypropylene fiber to the light weight self-compacting concrete resulted in 40% reduction in the slump flow from 720 mm to 430 mm. On compressive strength and elastic modulus of light weight self-compacting concrete the polypropylene fibers did not impact. However applying these fibers at their maximum percentage volume determined through this study, the results shows that it increases the tensile strength by 14.4% in the splitting tensile strength test, and 10.7% in the flexural strength in flexural test. [7]

K. Vijaia, R. Kumuthaa and B. G. Vishnuramb, author examined the different properties of hardened concrete such as density, compressive strength, split tensile strength and flexural strength of Geopolymer Concrete Composites (GPCC) containing 90% Fly ash (FA), 10% Ordinary Portland Cement (OPC), alkaline liquids and glass fibers. Glass fibers were added to the concrete in volume fractions of 0.01%, 0.02% and 0.03% by volume of concrete. The study represent replacement of 10% of fly ash by OPC in GPC mix eliminates the two limitations of Geopolymer Concrete (GPC mix) such as delay in setting time and necessity of heat curing to gain strength which results in Geopolymer Concrete Composite (GPCC mix). Used the test result of 7 and 28 days of compression, flexure and split tensile strength by ambient and heat curing to conclude that as glass fiber percentage increases strength increases.[1]

Mr.R.Balamurugan et.al, in this paper to increase the strength of concrete quality wise author adds glass fiber in concrete and replaces conventional concrete with geopolymer concrete. To determine the mechanical properties of glass fiber geopolymer concrete (GGPC), which contains fly ash, alkaline liquid and glass fibers. Alkaline liquid to fly ash ratio was fixed as 0.35% by volume of cement and add the glass fibers in the ratio of 1%, 2%, and 3% by volume of concrete. From experimental research, results and comparison author stated that glass fibers shown good results. Compressive strength, flexural strength and split tensile strength for these glass fibers are more as compared to Conventional concrete. It can also be concluded that Flexural strength and split tensile strength shows almost 40 to 50% increase in strength as compared to 0% glass fibers. It also concluded that Compression strength shows almost 20 to 30% increase in strength as compared to 0% glass fibers. Geopolymer concrete possessed the ability to enhanced mechanical properties than conventional concrete of the same grade. The compressive strength is found to be much more for normal concrete with the addition of glass fibers as compared to the geopolymer concrete with the addition of glass fibers. [2]

3. METHOLOGY-

3.1 Materials-

The material used for making glass fiber reinforced geopolymer concrete are low calcium dry fly ash as source material, alkaline liquid, coarse aggregate, fine aggregate, cement, lime, glass fiber and water.

3.1.1 Fly Ash-

Fly ash is a residue of combustion of pulverized coal collected by mechanical or electrostatic separators from the chimney gasses of thermal power plants. The spherical form of fly ash particles improves the flow ability & reduces the water demand. In this experimental work low calcium dry fly ash (Pozzocrete-83) produced from Dirk India

limited, Nashik obtained from Ekalahare (Nashik) thermal power station. The fineness of fly ash particle of specific surface was 368 m^2/kg.

3.1.2 Alkaline liquid-

A combination of sodium hydroxide and sodium silicate solution was used as alkaline activators for geopolymerization. Sodium hydroxide is available in market in pallet and flakes form. In this experimental study sodium hydroxide flakes with 97% purity of 13 molarity dissolved in distilled water to prepare NaOH solution. Sodium silicate generally available in white viscous solution form uses along with sodium hydroxide. The chemical composition of sodium silicate is Na_2O=14.53%, SiO_2=23.72% (Total Solids = 38.25%), Water = 61.75%.

3.1.3 Aggregate

Course aggregate of size up to 20mm having fineness modulus 6.66, bulk density of 1630 kg/m^3 and specific gravity of 2.603 were used. Fine aggregate is cleaned dry river sand having specific gravity 2.576 and fineness modulus 3.35 was used.

3.1.4 Cement

Cement used in concrete to replacement of fly ash by 10% to avoid the heat curing limitation in geopolymer concrete. The most common type of cement used is Ordinary Portland cement of 53 grades.

3.1.5 Lime

The locally available hydrated lime which generally used as construction material was used for early setting at room temperature. Lime was added in 10% as replacement of fly ash. The lime is a solid composite material having specific gravity 2.7 and bulk density 1425 kg/m3. It comes in solid lump form when convert it to powder form has average particle size of 25micron.

3.1.6 Glass fiber

Glass fibers are made of silicon oxide with addition of small amount of other oxides Glass fibers are characteristic for their high strength, good temperature resistance, corrosion resistance & available at low price. In this study alkali resistance glass fiber of length 12mm & nominal diameter 14 microns with density of 2680Kg/m3 going to use used the above data provided by supplier.

4. RESULT AND DISCUSSION-

Geopolymer concrete is the technic which can be use as alternative of conventional concrete. It is eco-friendly composite material and its material can cause low emission of Co2. Geopolymer concrete is the composite material of fly ash and alkaline liquid like sodium silicate and sodium hydroxide. This shows properties like high early strength, low shrinkage, and sulphate resistance so it can use for various constructions. After study the literature we can say that by partially replacing lime & cement to fly ash in geopolymer concrete can eliminate two limitation of geopolymer concrete such as delay in setting time and necessity of heat curing to gain strength. Ambient curing at room temperature to geopolymer concrete can also able to give satisfactory result. Glass fibers are thin fiber with high tensile strength which can help the geopolymer concrete to achieve more flexural strength. The study of adding glass fiber in geopolymer concrete with replacing lime and cement will make glass fiber geopolymer concrete easy to use under ambient curing.

5. REFERENCES

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